

# Prescribing and the core curriculum for tomorrow's doctors: BPS curriculum in clinical pharmacology and prescribing for medical students

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Prescribing is one of the commonest tasks expected of new doctors and is a complex process involving a mixture of knowledge, judgement and skills. Preparing graduates to be prescribers is one of the greatest challenges of modern undergraduate medical education and there is some evidence to suggest that training could be improved. The aims of this article are (i) to review some of the challenges of delivering effective prescribing education, (ii) to provide a clear statement of the learning outcomes in clinical pharmacology and prescribing that should be expected of all medical graduates and (iii) to describe a curriculum that might enable students to achieve these outcomes. We build on the previous curriculum recommendations of the British Pharmacological Society and take into account those of other key bodies, notably the General Medical Council. We have also reviewed relevant evidence from the literature and set our work in the context of recent trends in medical education. We divide our recommended learning objectives into four sections: principles of clinical pharmacology, essential drugs, essential therapeutic problems and prescribing skills. Although these will not necessarily be accepted universally we believe that they will help those who design and map undergraduate curricula to explore potential gaps and identify improvements.

## Introduction

Prescribing forms a significant component of the work of newly qualified doctors, and is probably the intervention that has the greatest influence on the health of their patients. Prescribing also represents the most challenging task for which they have to be prepared, involving a complex series of sub-competencies (Table 1), each of which demands a mixture of knowledge, judgement and skill [1]. Furthermore, the clinical environment in which prescribing occurs is evermore demanding as more medicines with increasingly complex pharmacology become available, patients become older and more vulnerable, there is more litigation and a greater need for cost-effective use of resources. It is perhaps not surprising that new doctors consider prescribing to be the most difficult aspect of their job and the one for which they feel least prepared [2]. A number of reports have highlighted that,

**Table 1**

Sub-competencies involved in the prescribing process

Make a diagnosis
Establish therapeutic goal
Choose the therapeutic approach (in discussion with the patient)
Choose the drug
Choose the dose route and frequency
Choose the duration of therapy
Write the prescription
Inform the patient
Monitor drug effects
Review/alter prescription in the light of further investigation

once they have been exposed to the workplace, junior doctors retrospectively consider that there was insufficient emphasis on the practical aspects of prescribing in the undergraduate curriculum [3], and that is a view shared by

many medical students [4]. The need for a careful review of the way medical students are trained to be prescribers has been brought into sharper focus by recent data showing that the 7–10% of the prescriptions written by this group contain errors [5, 6]. Whilst the rate of errors made by more experienced prescribers is also significant, the majority of UK hospital prescriptions are written by junior doctors, making them an important target for intervention [7].

## What are the aims of this curriculum?

The British Pharmacological Society (BPS) published a *Core Curriculum for Safe and Effective Prescribing* in 2003 [8]. There have been a number of developments in medical education in the intervening years, not least a wider recognition of the shortfall in prescribing education in some curricula [9], the need to provide more experiential learning during the undergraduate years (especially in relation to prescribing) and a move towards outcomes-based curricula. In 2007 the Medical Schools Council convened a Safe Prescribing Working Group that brought together representatives of important stakeholder groups including the BPS, General Medical Council (GMC), Postgraduate Deans, the National Patient Safety Agency, National Prescribing Centre, health service employers and medical students [10]. For the first time, all agreed about the outcomes that should be expected of medical graduates in relation to safe use of medicines and these, together with some others, were incorporated into the most recent version of *Tomorrow's Doctors* [11] (Table 2). The group also recommended that there should be a national e-Learning programme to support education in this area of the curriculum [12] and development of assessments that might enable medical students (and medical schools) to demonstrate that the required learning outcomes had been met [13].

The challenge for medical schools now will be to achieve the required outcomes given that they represent a significantly more ambitious target. The available data suggest that there is currently a marked variation in the learning provided by different schools [14] and some are likely to find the targets set by the GMC more difficult to meet than others.

The aim of this updated curriculum is to provide a clear and more detailed statement of the core learning required by medical graduates to achieve the outcomes set out by *Tomorrow's Doctors*. It is intended to provide a guide that will enable both medical students and medical schools to concentrate their efforts on ensuring the core aspects of clinical pharmacology and prescribing are delivered over the 5 years of a the standard undergraduate curriculum. The recommendations are informed by a Delphi consensus study undertaken as part of the recent BPS Prescribing

Initiative [15] and those made by other respected international bodies [16, 17].

For convenience we have divided the document into two parts. First, we cover some general recommendations about the delivery of the curriculum. Second, we describe in detail the learning objectives that should be achieved in order to meet the high level outcomes identified in the guidance above [10, 11]. These have been divided into four sections: principles of clinical pharmacology, essential drugs, essential therapeutic problems and prescribing skills.

## General recommendations

### Leadership

A key factor in the successful implementation of the core curriculum in clinical pharmacology (CPT) and prescribing will be strong and enthusiastic leadership from one or more individuals. They will be involved in negotiating sufficient time within the curriculum for students to achieve the learning objectives, signposting and coordinating those opportunities for the students, developing local resources (e.g. a student formulary, online learning materials) and ensuring that the assessment strategy adequately reflects the importance of prescribing as an outcome competency of a new doctor. This role will be particularly important if, as is increasingly common, clinical pharmacology is a curriculum thread with learning predominantly integrated as a recurrent theme in horizontal modules. All medical schools should be able to identify an individual who will ensure that the generic principles of safe and effective use of drugs are highlighted throughout the course. This role should ideally be undertaken by an individual with a training and background in clinical pharmacology, although it might be played by others with the enthusiasm and skills for ensuring that the relevant outcomes are achieved.

The coordination of CPT learning opportunities may be devolved to many teachers across the course, often within organ-based specialties. They too should be encouraged to emphasize generic prescribing principles and remind students about the effects of drugs beyond individual organ systems. Simply providing a link between drugs and clinical conditions is insufficient to develop an appreciation of the complex considerations that surround the decision to initiate a prescription. All schools should ensure that, in each clinical attachment, students are helped to tackle the practical issues of weighing the risks and benefits of drug therapy, prescribing the drug and monitoring the impact of therapy. Clinical pharmacists who are usually available in greater numbers than CPT specialists also have an important role to play in reinforcing learning during clinical attachments. This may involve, for example, explanation of the role of the clinical pharmacist, highlighting common issues and

**Table 2**

Learning outcomes identified in *Tomorrows Doctors*

8 The graduate will be able to apply to medical practice biomedical scientific principles, method and knowledge relating to anatomy, biochemistry, cell biology, genetics, immunology, microbiology, molecular biology, nutrition, pathology, pharmacology and physiology. The graduate will be able to:
(e) Select appropriate forms of management for common diseases, and ways of preventing common diseases, and explain their modes of action and their risks from first principles.
(f) Demonstrate knowledge of drug actions: therapeutics and pharmacokinetics, drug side effects and interactions, including for multiple treatments, long term conditions and non-prescribed medication and also including effects on the population, such as the spread of antibiotic resistance.
12 Apply scientific method and approaches to medical research.
(a) Critically appraise the results of relevant diagnostic, prognostic and treatment trials and other qualitative and quantitative studies as reported in the medical and scientific literature.
14 (g) Formulate a plan for treatment, management and discharge, according to established principles and best evidence, in partnership with the patient, their carers, and other health professionals as appropriate. Respond to patients' concerns and preferences, obtain informed consent, and respect the rights of patients to reach decisions with their doctor about their treatment and care and to refuse or limit treatment.
16 Provide immediate care in medical emergencies.
(b) Diagnose and manage acute medical emergencies.
17 Prescribe drugs safely, effectively and economically.
(a) Establish an accurate drug history, covering both prescribed and other medication.
(b) Plan appropriate drug therapy for common indications, including pain and distress.
(c) Provide a safe and legal prescription.
(d) Calculate appropriate drug doses and record the outcome accurately.
(e) Provide patients with appropriate information about their medicines.
(f) Access reliable information about medicines.
(g) Detect and report adverse drug reactions.
(h) Demonstrate awareness that many patients use complementary and alternative therapies, and awareness of the existence and range of these therapies, why patients use them, and how this might affect other types of treatment that patients are receiving.
18 b) Be able to perform a range of therapeutic procedures, as listed in Appendix 1.
21 (c) Continually and systematically reflect on practice and, whenever necessary, translate that reflection into action, using improvement techniques and audit appropriately, for example, by critically appraising the prescribing of others.
23 (d) Promote, monitor and maintain health and safety in the clinical setting, understanding how errors can happen in practice, applying the principles of quality assurance, clinical governance and risk management to medical practice, and understanding responsibilities within the current systems for raising concerns about safety and quality.
(e) Understand and have experience of the principles and methods of improvement, including audit, adverse incident reporting and quality improvement, and how to use the results of audit to improve practice.
Domain 5 – Design and delivery of the curriculum, including assessment
Standard
81 The curriculum must be designed, delivered and assessed to ensure that graduates demonstrate all the 'outcomes for graduates' specified in <i>Tomorrow's Doctors</i> .
86 All the 'outcomes for graduates' will be assessed at appropriate points during the curriculum, ensuring that only students who meet these outcomes are permitted to graduate. Assessments will be fit for purpose, that is, valid, reliable, generalizable, feasible and fair.
109 In the final year, students must use practical and clinical skills, rehearsing their eventual responsibilities as an F1 doctor. These must include making recommendations for the prescription of drugs and managing acutely ill patients under the supervision of a qualified doctor. This should take the form of one or more Student Assistantships in which a student, assisting a junior doctor and under supervision, undertakes most of the duties of an F1 doctor.
Appendix 1 – Practical procedures for graduates
16. Administering oxygen
17. Establishing peripheral intravenous access and setting up an infusion; use of infusion devices.
18. Making up drugs for parenteral administration.
19. Dosage and administration of insulin and use of sliding scales.
20. Subcutaneous and intramuscular injections.
21. Blood transfusion.
23. Instructing patients in the use of devices for inhaled medication.
24. Use of local anaesthetics.

errors, teaching about prescribing documentation, processes and information sources.

### Teaching methods

The learning outcomes can be achieved in any type of medical course, from traditional discipline-based to problem-based curricula. It is important that CPT and prescribing content is signposted as such so that students are

aware of when it is being delivered. This learning may take place across different modules and over several years using horizontal and vertical teaching strands. Learning should be constructed over the course with an initial focus in the early curriculum on understanding where and how drugs act, and a later emphasis on more clinical aspects, such as when drugs are indicated and how they are prescribed. A module in the early years that highlights generic

aspects of drug use and the principles of clinical pharmacology will provide a firm platform for later learning. With key principles established, much of the learning about drugs can then be undertaken within system-based modules.

As with any subject, CPT can be taught using the full range of large group, small group and self-directed learning. The mix of these elements will change over different parts of the course. Once students are on clinical attachments, there are many opportunities for using ward or clinic based examples of drug use. Students should be encouraged to learn about the whole process of prescribing, particularly the role of other healthcare professionals. This may involve shadowing nurses during drug administration rounds or observing the ward pharmacist reviewing patients. Some newer elements from postgraduate learning that are particularly suited to CPT may be adapted for use. These include case-based discussions between student and tutor, which could be used to focus on particular aspects of a patient's management.

Patient safety is now recognized as an important component of undergraduate education. Specific teaching on medication errors and how to avoid these should be a part of the curriculum, whether it is described as CPT or patient safety. Guidance is available from the WHO Patient Safety Curriculum Guide [18].

Another innovation that may contribute effectively to the teaching of CPT and prescribing is inter-professional learning. Safe and effective medication use involves collaboration between three healthcare professions. Therefore joint teaching of medical students with students of pharmacy and nursing can provide a realistic interactive environment that stimulates learning about medicines.

### Prescribing skills

Practical prescribing skills have traditionally been learned in an *ad hoc* way on clinical attachments but it is evident from recent surveys that this approach has, in some cases, provided very little or poor quality experience [4]. The gap between student apprentice prescriber and early postgraduate prescribing is still far too great. We believe strongly that this transition must be eased by providing much more of the 'learning curve' within the undergraduate curriculum. We reject the notion that prescribing can only be developed 'on the job' and believe that there are a number of ways of augmenting the undergraduate prescribing experience:

**1 Pre-prescribing.** This involves final year students writing prescriptions on real charts, which are clearly marked as 'pre-prescribed' until validated by a doctor [19]. This has echoes of the old student locum system but is more strictly regulated to reflect modern clinical governance concerns. While there remain concerns from some that a return to allowing unqualified staff to write on official documentation constitutes an unnecessary risk we

believe that this represents an illogical and short-sighted approach to risk management. The final year medical students of this month may be next month's busiest hospital prescribers, competence assumed, and often poorly supervised. Various studies have highlighted that this transition currently involves an unreasonable jump in responsibility [2, 3, 5, 6]. Pre-prescribing offers the opportunity to bring the steepest part of the 'learning curve' into undergraduate training where there is less time pressure and better supervision for the novice prescriber. This experiential learning approach is also consistent with the move to Student Assistantships recommended by the GMC in *Tomorrow's Doctors* [11]. Preliminary data suggest that this process is associated with a lower risk of error than standard ward prescribing [19].

**2 Tutorials.** A number of medical schools are now running ward-based practical sessions for their final year students that involve prescribing in response to common problems. While this style of teaching can be facilitated by a range of teachers (senior doctors, junior doctors, pharmacists), there has been a move in some medical schools to utilize 'near-peer' teaching led by foundation doctors [20]. This not only provides relevant practice for students but encourages reflective practice from the tutors.

**3 Prescribing simulation.** There are now some programmes available that allow prescriptions to be written in a virtual environment with rapid scoring and feedback provided. The fidelity of these simulations is likely to improve and they have the advantage of requiring no specific organization of the clinical environment and avoid posing any potential risk to patients.

It has been traditional that learning to prescribe is a task for the final year of the course when students are in the best position to be able to translate basic knowledge of diseases and medicines into a written prescription. We see no reason to delay this experience and feel that the challenge of writing simple prescriptions and early familiarity with the prescribing documentation will serve to improve the acquisition of knowledge, judgement and skills during clinical attachments.

### Student formularies

Another potentially helpful strategy is a student formulary. The large number of drugs that may be encountered during undergraduate training can be overwhelming for students who do not know where to start and what to learn. A student formulary can guide students to learn basic information about 80–100 core drugs, which can be used to illustrate principles and are sufficient to cover most drug classes used for common illnesses [21–23]. An example is given in appendix II of this curriculum but can be adapted to meet local guidance and usage. In appendix III, there is a list of common illnesses for which students should understand the basic principles of therapeutics.

### *e-Learning*

e-Learning strategies have become an increasingly popular and cost-effective approach to delivering undergraduate education. These are able to provide increasingly sophisticated learning opportunities in a virtual environment that are constantly available and can be tackled at a time and speed that suits the learner. As the change from paper to electronic prescribing spreads worldwide, aided by advances in virtual reality environments, this approach will be able to provide increasingly realistic simulation of real world therapeutics. There are now several national initiatives that are pooling CPT expertise to provide an integrated e-Learning to larger numbers of medical students [12, 24]. Many CPT departments have also successfully embedded web-based approaches, not only as an aid to learning but also for assessment. Initiatives include traditional interactive e-Learning modules but also other approaches such as online lectures, links to reference resources, discussion boards and formative assessment materials [25].

### *Prescribing assessment*

Few schools now have separate examinations in clinical pharmacology and therapeutics. However it is increasingly argued that new graduates should be able specifically to demonstrate competence in prescribing appropriate to starting work as doctors. Indeed, Para 117 of *Tomorrow's Doctors* states that, in relation to all major outcomes including 'Prescribing drugs safely and effectively':

Medical schools must have appropriate methods for setting standards in assessments to decide whether students have achieved the 'outcomes for graduates'. There must be no compensatory mechanism which would allow students to graduate without having demonstrated competence in all the outcomes.

This implies the need for robust assessments that test the relevant knowledge and skills. It is difficult to know whether this requirement is met but it is clear that there is a significant variation in the methods currently employed across different schools [14]. We believe that all medical schools should have validated and reliable schemes of assessment in place to ensure that students demonstrate that they have achieved 'competence' in relation to the curricular outcomes. We believe that this standard can best be described as

possession of sufficient knowledge, judgement and skills to prescribe (or supervise the use of medicines) in the role of a newly graduated doctor working within the UK national health service, taking into account the workload, case mix and level of supervision that can reasonably be expected.

It is important that assessments should not simply be knowledge-based but test the acquisition of practical skills (e.g. writing a prescription, offering information to a patient about a drug, planning management and spotting potentially dangerous prescriptions).

Two main methods of assessing CPT and prescribing have been described in the literature. Written questions (multiple choice or short answer) are commonly used. Although such questions are useful for measuring underlying knowledge, they have limited value for assessing prescribing skills. The objective structured clinical examination (OSCE) is an ideal format for this kind of assessment although it is a very resource intensive undertaking when it involves a large cohort of students. In the UK, the MSC and BPS are now collaborating to deliver an online *Prescribing Skills Assessment* that will provide a mixture of MCQ and prescribing items in an online environment [12].

### *Quality assurance*

As with any part of the curriculum, it is important that teaching and learning in CPT and safe prescribing is quality assured. This will involve ensuring that teachers maintain their own skills as educators and prescribers. In addition, it is vital that assessments are appropriately standard set and that their reliability and validity are kept under review. Examiner training and appraisal are critical in ensuring standardization, as highlighted in *Tomorrow's Doctors* [11]. The role of external examiners in helping medical schools to ensure assessments are in line with other institutions is important in guaranteeing new graduates have similar competences in prescribing. This document will support medical schools in this task, by providing outcomes relevant to prescribing for new graduates, as well as guidance on the range of drugs with which they should be familiar and common conditions for which they should know the principles of management.

## **Curriculum learning objectives**

### *Principles of clinical pharmacology*

This section will cover the basic principles of pharmacology, clinical pharmacology and toxicology that underpin rational prescribing. These topics will introduce students to some of the important generic principles of clinical pharmacology before they are applied to various areas of therapeutics (see Appendix I).

### *Essential drugs*

This section contains a list of commonly used drug classes and selected individual drugs with which students should be familiar before prescribing them, under the supervision of a senior doctor, and providing sufficient information about them to patients. Over the course of their undergraduate studies students would be expected to learn the mechanism of action, indications for use, contraindications

and adverse effects of these medicines. Senior students should also have an understanding of how to select appropriate drug doses, frequency, route of administration and duration of treatment for these drugs. While students should not be expected to remember exact drug doses, except perhaps for a small number of emergency drugs, they should know where to find information quickly and easily and understand the principles that underlie rational dose selection. This is an aspect that students and new doctors are often particularly concerned about and seek further guidance [3]. Students should also have a clear understanding of their responsibilities as prescribers and the limits of their competence. Each medical school may wish to adjust this formulary and populate it with exemplar drugs that suit local requirements. This list will change with time as the evidence base and clinical practice evolves (see Appendix II).

### *Essential therapeutics*

This section contains a list of common clinical conditions for which new graduates should understand basic patient management, though they should not necessarily be able to prescribe for all of these from day 1. Again medical schools may wish to adjust this list to suit their own priorities (see Appendix III).

### *Prescribing and related skills*

This section is a collection of common skills related to rational use of medicines. These will include writing prescriptions, calculating doses, preparing and administering drugs, accessing reliable information about drugs and reporting adverse drug reactions. See Appendix IV.

## **Conclusion**

Preparation for prescribing is arguably the major challenge facing undergraduate medical education at this time. Good prescribing requires a sound understanding of the principles of clinical pharmacology, knowledge of medicines, appreciation of uncertainty and good judgement, ideally based on experience. There are currently significant concerns about the frequency of prescribing errors in all healthcare systems. While improved training of prescribers is only part of a wider solution, it is clear that given the scale of the problem everything possible should be done to ensure that new graduates are optimally prepared.

## **Competing Interests**

There are no competing interests to declare.

## **Appendix I Principles of clinical pharmacology**

This appendix provides a list of learning outcomes expressing what a graduate should be able to do after completing

five years of undergraduate study. These have been arranged under major and minor headings, the latter corresponding to the potential content of a single learning event addressing around 4 to 6 outcomes.

## **Introduction to Clinical Pharmacology and Therapeutics**

### *• Introduction*

- Explain the terms pharmacology, clinical pharmacology and therapeutics
- Recognize the breadth of topics embraced by clinical pharmacology
- Recognize the importance of clinical pharmacology as the scientific discipline that underpins a rational approach to prescribing medicines

### *• Drugs in healthcare and society*

- Explain the terms drug and medicine
- Explain the extent of medicines use within the NHS
- Recognize the impact of prescription drugs in society
- Explain the extent of illicit drug use and its public health consequences

## **Pharmacodynamics**

### *• Mechanisms of drug action*

- Define the term pharmacodynamics
- Identify molecular targets for drug action including receptors, ion channels, enzymes and transporters
- Identify cellular mechanisms of action including excitation, contraction and secretion
- Describe how these actions translate into responses at the tissue and organ level

### *• Dose–response relationships*

- Explain the relationship between drug dose and response
- Define the terms agonist, antagonist and partial agonist
- Explain the effect of antagonists on the dose–response curve of an agonist
- Explain the assessment of receptor selectivity
- Define the terms efficacy and potency
- Define the term ‘therapeutic index’
- Describe the phenomena of desensitization and tolerance

## **Pharmacokinetics**

### *• Introduction to pharmacokinetics*

- Explain the term pharmacokinetics
- Explain the four phases of pharmacokinetics
- Explain why an understanding of pharmacokinetics is relevant to prescribers

- *Drug absorption*
  - Explain the mechanisms of drug movement across physiological barriers
  - Explain fundamental differences between various routes of drug administration
  - Describe first pass metabolism and its importance
  - Describe how one drug can influence the absorption of another
- *Drug distribution*
  - Explain the distribution of drugs across body compartments
  - Define volume of distribution
  - Explain how the distribution of a drug influences its pharmacokinetics
- *Drug metabolism and excretion*
  - Define phase I and II metabolism
  - Explain the important role of the liver in drug metabolism
  - Explain why drug metabolism is a potential point of interaction between drugs
  - Explain the important routes of drug excretion from the body
- *Concentration–time relationships*
  - Describe the typical concentration–time curve for a drug with first order kinetics
  - Explain the importance of zero order (saturation) kinetics
  - Define clearance and half-life
  - Define bioavailability
- *Repeated drug dosing*
  - Explain the pharmacokinetic factors that determine choice of dose, route and frequency of drug administration
  - Explain the pharmacokinetics of repeated dosing including time to 'steady-state'
  - Explain fundamental differences between drugs with long and short half-lives
  - Explain the rationale for loading doses

### Individual variability in the response to drugs

- *Overview*
  - Identify the main factors influencing variability in response
  - Explain how different pharmaceutical factors produce variation in response
  - Explain how altered pharmacokinetic handling of drugs produces variation in response
  - Explain how pharmacogenetic variation can influence the response to drugs
  - Explain how pharmacodynamic factors can affect drug response (e.g. receptor sensitivity, tolerance, organ-disease)
- *Pharmacokinetic variability*
  - Identify important groups of patients where pharmacokinetic handling of drugs altered is altered

- Explain in each of the cases above why handling is altered
- Explain in each of the cases above how this might have been predicted and the adjustments that might have to be made by prescribers
- *Pharmacogenetic variability*
  - Identify common ways in which genetic variation influences the handling and response to drugs
  - Provide common examples where pharmacogenetic variation influences prescribing
  - Explain how increasing knowledge of pharmacogenetic variation will influence future prescribing practice

### Adherence, compliance and concordance

- *Adherence to medication*
  - Define the terms adherence and compliance, separating them from concordance
  - Explain the scale of non-adherence and its consequences
  - Identify measures to improve poor adherence whether intentional or unintentional
  - Make an accurate assessment of adherence to medication
- *Concordance – partnership with patients*
  - Define the term concordance
  - Describe the influence of patients' beliefs on adherence
  - Identify the barriers to achieving shared decision making with patients
  - Explain ways in which concordance can be improved (e.g. presenting accessible information)
  - Describe how to discuss the benefits and risks of drug therapy with patients
  - Describe how to explore patients' views and wishes in relation to drug treatment

### Monitoring drug therapy

- *Overview*
  - Explain the importance of monitoring the impact of drug therapy
  - Describe the ways in which therapy can be monitored including clinical outcomes, pharmacodynamic responses and plasma drug concentrations
  - Identify the prerequisites, advantages and disadvantages of each approach
  - Identify common examples of where monitoring drug concentrations are important
- *Using drug effect*
  - Identify ways in which drug effects can be measured
  - Explain why the impact of drugs on clinical outcomes is difficult to measure
  - Identify the difference between a surrogate and hard outcome
  - Explain what makes a good surrogate outcome

- *Using drug concentration*

- Explain the variable relation between dose and plasma drug concentration, and between drug concentration and effect
- Describe the characteristics that make a drug suitable for monitoring by measurement of concentration
- List common medicines whose use is facilitated by measurement of drug concentration
- Describe the practicalities of measuring plasma drug concentrations
- Explain how to interpret drug concentration measurements appropriately
- Explain how to adjust dosage in light of drug concentration measurements

## Adverse drug reactions

- *Basic principles*

- Define an adverse drug reaction and other adverse outcomes of drug therapy
- Explain the frequency of adverse drug reactions and their impact on public health
- Explain why all drugs have both beneficial and adverse effects
- Describe the common classification of adverse drug reactions (e.g. ABCDE)
- Explain the alternative classification based on dose, timing and susceptibility (e.g. DOTS)

- *Drug allergy*

- Discuss risk factors for allergy/anaphylaxis
- List medicines that are commonly implicated in allergic reactions
- Explain how to identify and characterize an allergic drug reaction
- Explain the importance of accurate diagnosis and recording of allergic reactions to drugs
- Explain the precautions that should be taken to prevent allergic reactions

- *Diagnosis, interpretation and management*

- Describe the principles of assessing drugs as a possible cause of new symptoms and signs
- Explain how to respond if an adverse drug reaction is suspected
- Explain how to manage a suspected adverse drug reaction

- *Avoiding adverse drug reactions*

- Describe important risk factors that predict susceptibility to adverse drug reactions
- Describe how identification of those risk factors can influence prescribing decisions
- Identify sources of information about adverse drug reactions
- Explain the importance of warnings and monitoring in preventing adverse reactions

- *Pharmacovigilance*

- Explain the ways in which adverse drug reactions can be identified (e.g. drug development, voluntary reporting, record linkage)
- Explain why the adverse drug reaction profile of individual drugs is unclear at launch
- Discuss the importance of and the prescriber's responsibility in pharmacovigilance
- Describe how to report a suspected adverse drug reaction using an on-line Yellow Card

## Drug interactions

- *Overview*

- Explain the potential for interacting drugs to cause beneficial and harmful effects
- Recognize the main ways in which interactions occur (e.g. pharmacokinetic, pharmacodynamic)
- Explain why the potential for drug interactions is increasing
- Identify sources of information about drug interactions to inform prescribing
- Explain how to predict and avoid drug interactions
- Explain how to adjust drug dosage in anticipation of a drug interaction that cannot be avoided

- *Liver metabolism*

- Explain the importance of liver cytochromes as a point of drug clearance
- Identify the importance of liver metabolism as a point of interaction between drugs
- Explain how liver enzyme metabolism can be inhibited and the impact this has on drug handling
- Explain how liver enzyme metabolism can be induced and the impact this has on drug handling

## Medication errors

- *Frequency and causes*

- Define medication errors, including subtypes
- Describe human error theory in simple terms
- Identify individual and systems factors leading to error
- Describe how medication errors are reported
- Explain how to respond when a medication error is discovered

- *Prevention*

- Explain how prescribers can reduce error
- Explain the importance of collaboration with pharmacists in preventing errors
- Explain how to identify and correct errors
- Describe the role of electronic prescribing and other approaches in reducing prescribing error

## Drug development and regulation

- *Drug development*
  - Explain in simple terms how drugs are discovered
  - Explain the various stages of development (preclinical, phase I to phase IV)
  - Explain the risks and costs involved in developing drugs
- *Clinical trials*
  - Classify the different forms of clinical trial and explain their advantages and disadvantages
  - Describe the requirements of a good clinical trial including consent, ethics, bias, statistics and dissemination of information
- *Drug regulation*
  - Explain why drugs need to be regulated
  - Identify the major regulatory authorities in the UK and Europe
  - Describe the approval process for new drugs in simple terms
  - Explain the importance of market exclusivity and patents
  - Explain how drug sales can be protected when patents expire
- *Drug marketing*
  - Explain the basics of how drugs are marketed by the pharmaceutical industry
  - Explain the legal constraints on the marketing process
  - Recognize the role of the ABPI code of conduct
  - Describe the potential for the marketing process to change attitudes
  - Identify the uses and abuses of the drug promotion process

## Medicines management

- *National processes*
  - Describe how new medicines are assessed on the basis of safety, efficacy and cost-effectiveness
  - Describe the basic principles of pharmacoeconomic assessments
  - Describe the roles of the National Institute for Health and Clinical Excellence (NICE) and equivalent bodies
- *Local processes*
  - Describe the role of local committees
  - Explain the role of local formularies and guidelines in the choice and use of medicines
  - Identify the factors that influence individual prescribing choices and why these have to be limited (e.g. cost, antibiotic resistance)
  - Explain the responsibility of prescribers to avoid wasteful prescribing and consumption of limited resources
- *Formularies*
  - Explain the relationship between the British National Formulary and local formularies
  - Explain the reasons for creating limited lists of medicines

- Explain the processes involved in creating a formulary
- Identify the important issues relating to coordination of prescribing in primary and secondary care
- *Guidelines*
  - Describe the definition and purpose of a clinical guideline
  - Explain some of the potential limitations and harms of clinical guidelines
  - Describe the optimal development, dissemination and implementation of clinical guidelines
  - Describe the legal standing of guidelines
- *British National Formulary*
  - Explain the history and development of the British National Formulary
  - List the important resources contained within the British National Formulary
  - Explain the limitations of the information contained in the British National Formulary

## Evidence-based prescribing

- *Overview*
  - Explain the extent of the evidence base
  - Explain the terms randomized controlled trial, cohort study, case control study, systematic review and meta-analysis
  - Identify different kinds of evidence and their hierarchy in terms of validity
  - Explain the limitations of applying clinical trial data to individual patients
  - Explain the importance of keeping one's prescribing practice up to date with advances in medical knowledge
- *Critical appraisal of clinical studies*
  - Describe the process of critical appraisal of clinical studies
  - Explain the approach to identifying methodological flaws, including sources of bias
  - Differentiate between true and surrogate endpoints
  - Explain the concept of external validity and problems with extrapolating clinical trial results
- *Finding reliable information about drugs*
  - Identify important information resources that might inform prescribing decisions
  - Explaining how prescribers can keep up to date with change
  - Identify potential sources of unreliable information

## Ethical and legal aspects of prescribing

- *Legal aspects of prescribing*
  - Explain the legal categorisation of drugs into general sales list, pharmacy medicines, prescription only medicines and controlled drugs

- Explain who is entitled to prescribe medicines and the legal requirements involved
- Explain who is entitled to supply medicines and the legal requirements involved
- Describe the legal requirements associated with prescribing controlled drugs
- Explain common ways that drugs can be supplied illegally (e.g. internet pharmacy)
- *Prescribing outside marketing authorization*
  - Recognize the circumstances in which drugs are prescribed 'off-label'
  - Explain the additional responsibilities associated with prescribing 'unlicensed' or 'off-label' medicines
  - Describe what information should be given to patients to allow them to make informed decisions about 'off-label' treatment
- *Ethical aspects of prescribing*
  - Explain the responsibilities of prescribing in a resource limited healthcare system
  - Describe the sometimes conflicting responsibilities to individual patients and the wider healthcare community
  - Explain the reasons for adhering to therapeutic guidelines and drug formularies, as appropriate
  - Explain why it is important to recognize limits of competence and to ask for help when needed
  - Explain the responsibility of all prescribers to update their knowledge

### **Prescribing for patients with special requirements**

- *Prescribing for patients with impaired liver function*
  - Describe how altered physiology, pharmacokinetic handling and pharmacodynamic response occur in patients with impaired liver function
  - List common medicines that are especially likely to cause harm to patients with impaired liver function
  - Discuss the principles involved in selecting medicines and designing dosage regimens for patients with impaired liver function
  - Explain where to find relevant information about choosing and adjusting drug dosage in patients with impaired liver function
- *Prescribing for patients with impaired renal function*
  - Describe how altered physiology, pharmacokinetic handling and pharmacodynamic response occur in patients with impaired renal function
  - List common medicines that are especially likely to cause harm to patients with impaired renal function
  - Discuss the principles involved in selecting medicines and designing dosage regimens for patients with impaired renal function
  - Explain where to find relevant information about choosing and adjusting drug dosage in patients with impaired renal function

- *Prescribing for elderly patients*
  - Describe how altered physiology, pharmacokinetic handling and pharmacodynamic response occur in elderly patients
  - List common medicines to which elderly patients are especially likely to respond differently
  - Explain where to find relevant information about choosing and adjusting drug dosage in elderly patients
  - Explain the principles that underlie prescribing in the elderly
- *Prescribing for pregnant women and women of child-bearing potential*
  - Explain the reasons for caution when prescribing for pregnant women and women of child-bearing potential
  - Describe how altered physiology, pharmacokinetic handling and pharmacodynamic response occur in pregnancy
  - List common medicines to which pregnant women are especially likely to respond differently
  - Describe the possible effects of drugs on the developing foetus, in relation to the stage of gestation
  - Explain the principles involved in selecting medicines and designing dosage regimens for pregnant women and women of child-bearing potential
  - Explain where to find relevant information about choosing and adjusting drug dosage in pregnant women and women of child-bearing potential
- *Prescribing during lactation*
  - Explain the reasons for caution when prescribing for women who are breast feeding
  - List common medicines that are especially likely to cause harm to the newborn as a result of transmission via breast milk
  - Discuss the principles involved in selecting medicines and designing dosage regimens for women who are breast feeding
  - Explain where to find relevant information about choosing and adjusting drug dosage in women who are breast feeding
- *Prescribing for children*
  - Describe how altered physiology, pharmacokinetic handling and pharmacodynamic response occur in children
  - List common medicines to which children are especially likely to respond differently
  - Explain where to find relevant information about choosing and adjusting drug dosage in children
  - Explain the principles that underlie prescribing in children

### **Rational prescribing**

- *Rational approach to prescribing*
  - Explain the importance of individualizing the prescription

- Describe the selection of an appropriate medicine based on its comparative efficacy, safety, convenience and cost
- Explain the importance of identifying diagnosis (if possible) and therapeutic objectives
- Describe the factors that influence the choice of formulation, dose, route, frequency and duration of treatment
- Provide examples of irrational prescribing
- *Dose selection*
  - Explain the importance of accurate calculation of drug dosage, especially for intravenous infusions
  - Interpret different expressions of drug concentration or dose and be able to convert them
  - Calculate appropriate doses for individual patients, based on age, body weight and surface area
  - Explain how to select drug dosage using widely available nomograms
  - Identify factors that may necessitate amendments of standard doses

## Clinical toxicology

- *Principles of assessing poisoned patients*
  - Explain the epidemiology of poisoning
  - Describe the principles of assessment of a poisoned patient
  - Discuss the role of urine and blood sampling in poisoned patients
  - Describe the clinical features of overdosage with commonly used medicines (e.g. paracetamol, salicylates, tricyclic antidepressants, opioids and benzodiazepines)
- *Principles of treating poisoned patients*
  - Describe the principles involved in treating a poisoned patient
  - Explain how to access and obtain information from the National Poisons Information Service (e.g. TOXBASE)
  - List drugs and toxins to which effective antidotes are available
  - Explain the means by which the elimination of drugs or toxins can be hastened

## Misuse of drugs

- *Misuse of drugs*
  - List drugs that are commonly misused (e.g. cannabis, ecstasy, hallucinogens, volatile solvents, cocaine, opiates) and some of their important pharmacodynamic effects
  - Explain the legal classification of drugs
  - Describe the epidemiology of drug misuse in the population
  - Define tolerance, physical dependence and psychological dependence

## Complementary and alternative medicines

- *Complementary and alternative medicines*
  - Describe the extent of the popularity of complementary therapeutic approaches
  - Identify the motivations that lead patients to seek complementary and alternative therapies
  - Describe common therapies used by practitioners of complementary and alternative medicine and the evidence for their efficacy and safety
  - Explain the potential of complementary and alternative medicines to cause adverse effects
  - Describe the regulation of complementary and alternative medicines

## Appendix II Drugs (a 'student formulary')

This appendix provides a potential list of drug classes (with exemplar drugs) with which a graduate should be familiar after completing 5 years of undergraduate study. For each they should be able to describe the mechanism of action, indications for use, relevant contraindications and adverse effects to a depth that will enable them to anticipate their clinical effects, communicate effectively with colleagues and counsel patients.

### Gastrointestinal system

- *Peptic ulcer disease*
  - Antacids
  - H<sub>2</sub>-receptor antagonists (e.g. ranitidine)
  - Proton pump inhibitors (e.g. omeprazole)
- *Antidiarrhoeal drugs*
  - Antimotility drugs (e.g. codeine, loperamide)
- *Laxatives*
  - Laxatives (e.g. bran, ispaghula husk, senna, lactulose)
- *Antispasmodic drugs*
  - Antispasmodics (e.g. mebeverine, atropine)
- *Inflammatory bowel disease*
  - Aminosalicylates (e.g. mesalazine)
  - Biologics (e.g. infliximab)

### Cardiovascular system

- *Diuretics*
  - Thiazide diuretics (e.g. bendroflumethiazide)
  - Loop diuretics (e.g. furosemide)
  - Potassium-sparing diuretics (e.g. amiloride, spironolactone)
- *$\beta$ -adrenoceptor blocking drugs*
  - $\beta$ -adrenoceptor blocking drugs (e.g. atenolol, bisoprolol)

- *Calcium channel blockers*
  - Calcium channel blockers (e.g. amlodipine, verapamil)
- *Nitrates and potassium channel activators*
  - Nitrates (e.g. glyceryl trinitrate)
  - Potassium channel activators (e.g. nicorandil)
- *Drugs affecting the renin-angiotensin system*
  - ACE inhibitors (e.g. ramipril)
  - Angiotensin II receptor antagonists (e.g. losartan)
- *$\alpha$ -adrenoceptor blocking drugs*
  - $\alpha$ -adrenoceptor blocking drugs (e.g. doxazosin)
- *Anti-arrhythmic drugs*
  - Digoxin
  - Amiodarone
- *Anti-platelet drugs*
  - Anti-platelet drugs (e.g. aspirin, clopidogrel)
- *Thrombolytics*
  - Thrombolytic drugs (e.g. alteplase)
- *Anticoagulants*
  - Heparins (unfractionated, low molecular weight)
  - Oral anticoagulants (e.g. warfarin)
- *Lipid-lowering drugs*
  - Statins (e.g. simvastatin)

## Respiratory system

- *Oxygen*
  - Oxygen therapy
- *Bronchodilators*
  - $\beta_2$ -adrenoceptor agonists (e.g. salbutamol, salmeterol)
  - Antimuscarinics (e.g. tiotropium)
  - Theophylline
- *Corticosteroids*
  - Inhaled corticosteroids (e.g. beclometasone, compound bronchodilators)
- *Other drugs for respiratory disease*
  - Cromoglicate
  - Leukotriene receptor antagonists (e.g. montelukast)

## Nervous system

- *Drugs for Parkinson's disease*
  - Levodopa and dopa-decarboxylase inhibitors (e.g. co-careldopa)
  - Antimuscarinic antiparkinsonian drugs (e.g. procyclidine)
  - Other antiparkinsonian drugs (e.g. bromocriptine)
- *Drugs used to treat epilepsy*
  - Anticonvulsant drugs (e.g. phenytoin, carbamazepine, valproate, gabapentin)
- *Drugs used to treat migraine*
  - 5-HT<sub>1</sub>-receptor agonists (e.g. sumatriptan)
- *Drugs used for nausea and vomiting*
  - Anti-emetic drugs (e.g. cyclizine, metoclopramide, prochlorperazine, ondansetron)

- *Drugs for dementia*
  - Acetylcholinesterase inhibitors (e.g. donepezil, rivastigmine)

## Psychiatric disease

- *Anxiolytic and hypnotic drugs*
  - Benzodiazepines (e.g. diazepam, temazepam)
  - Z-drugs (e.g. zopiclone)
- *Antidepressant drugs*
  - Tricyclic antidepressants (e.g. amitriptyline)
  - Selective serotonin reuptake inhibitors (e.g. fluoxetine, citalopram)
  - Other antidepressant drugs (e.g. monoamine oxidase inhibitors)
- *Antipsychotic drugs*
  - Antipsychotic drugs (e.g. haloperidol, olanzapine)
- *Mood stabilizers*
  - Mood stabilizers (e.g. lithium)
- *Drugs of abuse*
  - Opioids
  - Cannabis
  - Amphetamine
  - Cocaine

## Infectious disease

- *Antibacterial drugs*
  - Penicillins (e.g. benzylpenicillin, amoxicillin, flucloxacillin)
  - Cephalosporins (e.g. cefuroxime)
  - Other broad spectrum antibiotics (e.g. meropenem, macrolides, quinolones, tetracyclines, trimethoprim)
  - Aminoglycosides (e.g. gentamicin) and vancomycin
  - Antituberculous drugs (e.g. isoniazid, rifampicin, ethambutol)
- *Antifungal drugs*
  - Antifungal drugs (e.g. clotrimazole, amphotericin, nystatin)
- *Antiviral drugs*
  - Antiviral drugs (e.g. aciclovir)
- *Antiprotozoal drugs*
  - Antimalarial drugs (e.g. chloroquine)
  - Metronidazole

## Endocrine system

- *Drugs for diabetes*
  - Insulins
  - Metformin
  - Oral hypoglycaemic agents (e.g. sulphonylureas, thiazolidinediones, dipeptidyl peptidase-4 inhibitors)

- *Thyroid disease*
  - Levothyroxine, propranolol, carbimazole
- *Osteoporosis*
  - Bisphosphonates (e.g. alendronic acid)
  - Other drugs used in osteoporosis treatment and prophylaxis (e.g. calcium, vitamin D, oestrogens and related drugs)
- *Corticosteroids*
  - Corticosteroids (e.g. hydrocortisone, dexamethasone, prednisolone)

## Renal and urological disease

- *Immunosuppressant drugs*
  - Immunosuppressants (e.g. ciclosporin, azathioprine, cyclophosphamide, tacrolimus)
- *Drugs for benign prostatic hypertrophy*
  - $\alpha$ -adrenoceptor blockers (e.g. doxazosin), finasteride, gonadorelin analogues (e.g. goserelin)

## Obstetrics and gynaecology

- *Female sex hormones*
  - Female sex hormones (e.g. oestrogens, progestogens, combined oral contraceptives)
- *Oxytocic drugs*
  - Oxytocic drugs (e.g. prostaglandins, ergometrine, oxytocin)

## Genitourinary disease

- *Drugs for HIV infection*
  - Nucleoside reverse transcriptase inhibitors (e.g. zidovudine)
  - Protease inhibitors (e.g. darunivir)
  - Non-nucleoside reverse transcriptase inhibitors (e.g. nevirapine)

## Skin, eyes and ENT

- *Drugs for allergic rhinitis*
  - Antihistamines (e.g. cetirizine, chlorphenamine)
- *Drugs for the eyes*
  - Hypromellose eye drops
  - Prostaglandin analogues (e.g. latanoprost)
- *Drugs for the skin*
  - Emollients
  - Topical corticosteroids (e.g. hydrocortisone cream)
  - Acne (e.g. benzoyl peroxide, topical and systemic retinoids)

## Oncology

- *Cancer chemotherapy*
  - Alkylating drugs (e.g. cyclophosphamide)
  - Cytotoxic antibiotics (e.g. doxorubicin)
  - Anti-metabolites (e.g. methotrexate)
  - Anti-oestrogens (e.g. tamoxifen, anastrozole)

## Locomotor system

- *Analgesic drugs*
  - Non-steroidal anti-inflammatory drugs (e.g. ibuprofen, diclofenac)
- *Disease-modifying anti-rheumatic drugs*
  - Disease-modifying anti-rheumatic drugs (e.g. sulphasalazine, methotrexate)

## Surgery, anaesthetics and intensive care

- *Anaesthetic drugs*
  - Inhalational anaesthetic drugs (e.g. halothane)
  - Intravenous anaesthetics (e.g. thiopental sodium)
  - Local anaesthetic drugs (e.g. lidocaine)
  - Muscle relaxants (e.g. suxamethonium)
- *Analgesic drugs*
  - Paracetamol and combination analgesics (e.g. co-codamol, co-dydramol)
  - Opioids (e.g. codeine, tramadol, morphine sulphate)
- *Drugs used for nausea and vomiting*
  - Anti-emetic drugs (e.g. cyclizine, metoclopramide, prochlorperazine, ondansetron)
- *Fluid replacement*
  - Intravenous fluids (e.g. 0.9% sodium chloride, glucose solutions, colloids)
  - Blood transfusion (and other blood products)

## Alternative therapy

- *Alternative therapy*
  - Homeopathy
  - Herbalism
  - Acupuncture
  - Aromatherapy

## Appendix III Therapeutics

This appendix provides a potential list of therapeutic problems with which a graduate should be familiar after completing 5 years of undergraduate study. For each they should be able to formulate a basic management plan and identify drugs (and non-pharmacological approaches) that might be indicated.

**Gastrointestinal system**

- *Peptic ulcer disease*
  - Peptic ulceration (including eradication of *H. pylori*)
  - Gastro-oesophageal reflux disease
- *Diarrhoea and constipation*
  - Acute diarrhoea
  - Constipation
- *Gastrointestinal infections*
  - Acute gastroenteritis
- *Irritable bowel syndrome*
  - Irritable bowel syndrome
- *Inflammatory bowel disease*
  - Ulcerative colitis
  - Crohn's disease
- *Liver disease*
  - Acute liver failure
  - Ascites

**Cardiovascular system**

- *Hypertension*
  - Adult hypertension
  - Hypertension in pregnancy
- *Angina pectoris*
  - Stable angina pectoris
- *Acute coronary syndromes*
  - Unstable angina/non-ST elevation myocardial infarction
  - Acute ST elevation myocardial infarction
- *Heart failure*
  - Acute pulmonary oedema
  - Chronic heart failure
- *Arrhythmias*
  - Atrial fibrillation
  - Supraventricular tachycardia
  - Ventricular arrhythmias
- *Cardiac arrest*
  - Cardiorespiratory arrest
- *Cardiovascular infection*
  - Acute bacterial endocarditis
- *Peripheral vascular disease*
  - Acute and chronic limb ischaemia
- *Thromboembolic disease*
  - Deep vein thrombosis
  - Pulmonary embolus
- *Hyperlipidaemia*
  - Hypercholesterolaemia
  - Hypertriglyceridaemia

**Respiratory system**

- *Asthma*
  - Acute asthmatic attacks
  - Stable asthma

- *Chronic obstructive pulmonary disease (COPD)*
  - Acute exacerbations of COPD
  - Stable COPD
- *Respiratory infections*
  - Bacterial pneumonias
  - Atypical pneumonias
  - Tuberculosis
- *Respiratory failure*
  - Hypoxaemia

**Nervous system**

- *Stroke*
  - Acute stroke
  - Primary and secondary prevention of stroke
- *Pain*
  - Principles of managing pain (including the analgesic ladder)
  - Neuropathic pain
- *Parkinson's disease*
  - Parkinson's disease
- *Epilepsy*
  - Status epilepticus
  - Chronic epilepsy
- *Migraine*
  - Acute migraine
  - Prophylaxis of migraine
- *Vertigo*
  - Vertigo
- *Nausea and vomiting*
  - Nausea and vomiting
- *Dementia*
  - Dementia
- *Muscle spasm*
  - Muscle spasm
- *Neurological infection*
  - Acute bacterial meningitis
- *Insomnia*
  - Insomnia

**Psychiatric disease**

- *Anxiety disorders*
  - Chronic anxiety
  - Acute panic
- *Depression*
  - Chronic depressive illness
  - Bipolar disorder
- *Schizophrenia*
  - Chronic schizophrenia
- *Acute behavioural disturbance*
  - Acute behavioural disturbance
- *Drug dependence*
  - Smoking cessation
  - Chronic opioid abuse

## Infectious disease

- *Gastrointestinal infections*
  - Acute gastroenteritis
- *Cardiovascular infection*
  - Acute bacterial endocarditis
- *Respiratory infections*
  - Bacterial pneumonias
  - Atypical pneumonias
  - Tuberculosis
- *Neurological infection*
  - Acute bacterial meningitis
- *Urological infection*
  - Urinary tract infection
- *Skin infections*
  - Cellulitis
- *Post-operative infections*
  - Post-operative wound infections
  - Post-operative peritonitis
- *Septicaemia*
  - Gram –ve septicaemia (and septicaemia of unknown cause)
- *Hospital-acquired infections*
  - *Clostridium difficile* infection
  - Methicillin-resistant staphylococcus aureus (MRSA) infection
- Infection in an immunocompromised host
  - Sepsis in an immunocompromised patient
- *Tropical infections*
  - Malaria

## Endocrine system

- *Type 1 diabetes*
  - Management of type 1 diabetes
  - Diabetic ketoacidosis
  - Hypoglycaemia
- *Type 2 diabetes*
  - Management of type 2 diabetes
- *Thyroid disease*
  - Hyperthyroidism
  - Hypothyroidism
- *Bone disease*
  - Osteoporosis
- *Adrenal disease*
  - Addison's disease (including Addisonian crisis)

## Renal and urological disease

- *Renal failure*
  - Chronic renal failure
  - Acute renal failure (including management of hypovolaemia)
- *Bladder disease*
  - Urinary tract infection
  - Incontinence and bladder instability

- *Prostate disease*
  - Benign prostatic hyperplasia
- *Impotence*
  - Impotence

## Obstetrics and gynaecology

- *Contraception*
  - Oral contraception
  - Contraception when oestrogens are contra-indicated
- *Menopause*
  - Menopausal symptoms

## Genitourinary disease

- *HIV infection*
  - Chronic HIV infection

## Haematological disease

- *Anaemia*
  - Iron deficiency anaemia
  - Macrocytic anaemias
  - Blood transfusion (and other blood products)

## Oncology

- *Cancer chemotherapy*
  - Adverse effects related to cancer chemotherapy
- *Palliative care*
  - Cancer-related pain
  - Palliation of symptoms in terminal malignant disease
- *Breast cancer*
  - Breast cancer

## Locomotor system

- *Osteoarthritis*
  - Osteoarthritis
- *Gout*
  - Acute gout
  - Prophylaxis of gout
- *Rheumatoid arthritis*
  - Rheumatoid arthritis
- *Temporal arteritis and polymyalgia rheumatica*
  - Temporal arteritis and polymyalgia rheumatica

## Diseases of the skin, eyes, ear, nose and throat

- *Diseases of the skin*
  - Chronic eczema
  - Psoriasis
  - Acne vulgaris
  - Cellulitis

- *Diseases of the eye*
  - Acute glaucoma
  - Chronic 'open-angle' glaucoma
- *Diseases of the ear, nose and throat*
  - Allergic rhinitis
  - Vertigo

### **Surgery, anaesthetics and intensive care**

- *Preparation of a patient for surgery*
  - Antibiotic prophylaxis
  - Thromboprophylaxis
  - Managing and amending regular medication (e.g. warfarin, insulin)
- *Post-operative treatment*
  - Post-operative pain (including patient-controlled analgesia)
  - Post-operative fluid replacement
  - Post-operative wound infections
  - Post-operative peritonitis

### **Accident and emergency medicine**

- *Overdoses*
  - Paracetamol poisoning
  - Salicylate poisoning
  - Tricyclic antidepressant poisoning
  - Acute opiate intoxication
  - Acute benzodiazepine intoxication
- *Alcohol problems*
  - Acute alcohol withdrawal
- *Allergic emergencies*
  - Acute anaphylaxis

## **Appendix IV Prescribing and related skills**

This appendix provides a list of learning outcomes expressing what a graduate should be able to do after completing 5 years of undergraduate study. These have been arranged under major and minor headings, the latter corresponding to the potential content of a single learning event addressing several outcomes.

### **Medication history taking**

- *Take a medication history*
  - Elicit and record an accurate medication history, including current and recent medicines, to support effective medicines reconciliation
  - Identify, where possible, for each drug the original indication, formulation, dose, route, duration and effects

- Ensure that over the counter, complementary medicines and the contraceptive pill are specifically included
- Identify alternative sources of information about current treatment, understand the limits of information sources and compensating for them
- Interpret the medication history so that allergies and ADRs can be identified (distinguish between a history of drug allergy and intolerance)
- Identify common potentially important drug interactions

### **Prescribe a new medicine**

- *Prescribe drugs safely, effectively and economically*
  - Define problem(s) to be treated
  - Define the therapeutic objective(s) for new therapy
  - Consider risks and benefits of specific drug therapies
  - Recognize drugs with a narrow therapeutic index or high potential for serious adverse effects/interactions, and take appropriate precautions when prescribing them
  - Follow clinical guidelines, protocols and formularies where appropriate
- *Write prescriptions that take into account the needs of individual patients*
  - Consider possible contraindications, drug–drug interactions, previous ADRs, any special circumstances, age and gender, and diseases
  - Choose the appropriate formulation, dose, route, frequency and duration of a drug
  - Interpret data that is relevant to prescribing decisions (e.g. renal function, drug concentrations)
- *Other prescribing-related skills*
  - Document the rationale for new prescribing decisions in patient notes
  - Recognize the potential for medication errors and take steps to reduce the risks
  - Recognize situations where their prescribing skills are not sufficient, and seek advice before proceeding

### **Calculate drug doses**

- *Drug calculations*
  - Calculate appropriate doses for individual patients by weight and body surface area, and based on a nomogram
  - Convert doses between common units and convert between concentrations expressed as percentage and mass

### **Prescription writing**

- *Prescribe on hospital in-patient prescription charts*
  - Write an unambiguous, legible, complete and legal prescription

- Including approved name, appropriate form and route, correct dose, any other necessary instructions, and signature
- Avoid abbreviations and other ambiguities when writing a prescription
- Prescribe 'once only', regular and 'as required' medicines

#### *Prescribing on other documentation*

- Prescribe on hospital supplementary prescription charts
- Prescribe 'to take out' drugs on discharge from hospital
- Prescribe on general practice prescription forms (GP10)
- Keep accurate records of prescriptions and responses
- Cancel prescriptions appropriately

### **Communication**

- *Discussing prescribing options with patients*
  - Communicate treatment plan and instructions to patient, at a suitable level of information
  - Engage in shared decision making where appropriate
- *Discussing prescribing decisions with colleagues*
  - Communicate treatment plans and monitoring arrangements clearly with other members of staff, in both verbal and written form
  - Keep accurate written records of management plans
  - Write accurate discharge prescriptions and letter to GPs

### **Reviewing prescriptions**

- *Reviewing current lists of prescribed medicines*
  - Identify and correct prescription writing errors
  - Identify and manage inappropriate prescribing

### **Adverse drug reactions**

- *Managing, reporting and avoiding adverse drug reactions (ADRs)*
  - Assess and manage common ADRs and interactions in the context of current clinical situation
  - Report a suspected ADR using an on-line yellow card
  - Find information about adverse drug reactions

### **Obtaining information to support rational prescribing**

- *Find reliable sources of drug information*
  - Find information from the Summary of Product Characteristics
  - Find information from the paper and online *British National Formulary*
  - Find Poisons Information Services (e.g. TOXBASE)

### **Prescribing high risk medicines**

- *Oxygen*
  - Prescribe oxygen safely using appropriate documentation
  - Monitor the clinical effects of oxygen
- *Warfarin*
  - Prescribe warfarin safely using appropriate documentation
  - Monitor the clinical effects of warfarin
- *Insulin*
  - Prescribe insulin safely using appropriate documentation
  - Monitor the clinical effects of insulin
- *Intravenous fluids*
  - Prescribe intravenous fluids safely using appropriate documentation
  - Monitor the clinical effects of intravenous fluids

### **Drug administration**

- *Administering parenteral medicines*
  - Administer drugs by subcutaneous injection
  - Administer drugs by intramuscular injection
  - Administer drugs by intravenous injection
  - Administer drugs by intravenous infusion pumps
- *Administering medicines by other routes*
  - Administer drugs using an inhaler
  - Administer drugs using a nebulizer
  - Administer drugs to the eye
  - Administer drugs to the ear
  - Administer drugs to the skin

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